Enhanced Propagation of Viviparous Water Lilies

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INTRODUCTION

The market for water garden plants has recently become one of the fastest growing facets of environmental horticulture. The most popular flowering water garden plants include species and hybrids of both tropical and temperate (hardy) water lilies (*Nymphaea*). Reliance on inefficient vegetative propagation techniques, requirements for large production space, and extended time periods to produce a salable plant limit the producers' ability to rapidly adjust to changes in market demand. Consequently, demand for specific water lily cultivars, particularly new introductions, can exceed growers' production capacity. Unlike other horticultural crops, information on the specific cultural requirements for efficient nursery production of water garden plants is lacking (Kelley and Frett, 1986; Brumback, 1990).

Clearly, more efficient propagation techniques for water garden plant production, including use of micropropagation techniques, are needed to enable aquatic plant nurseries to remain competitive. To date, very limited progress has been

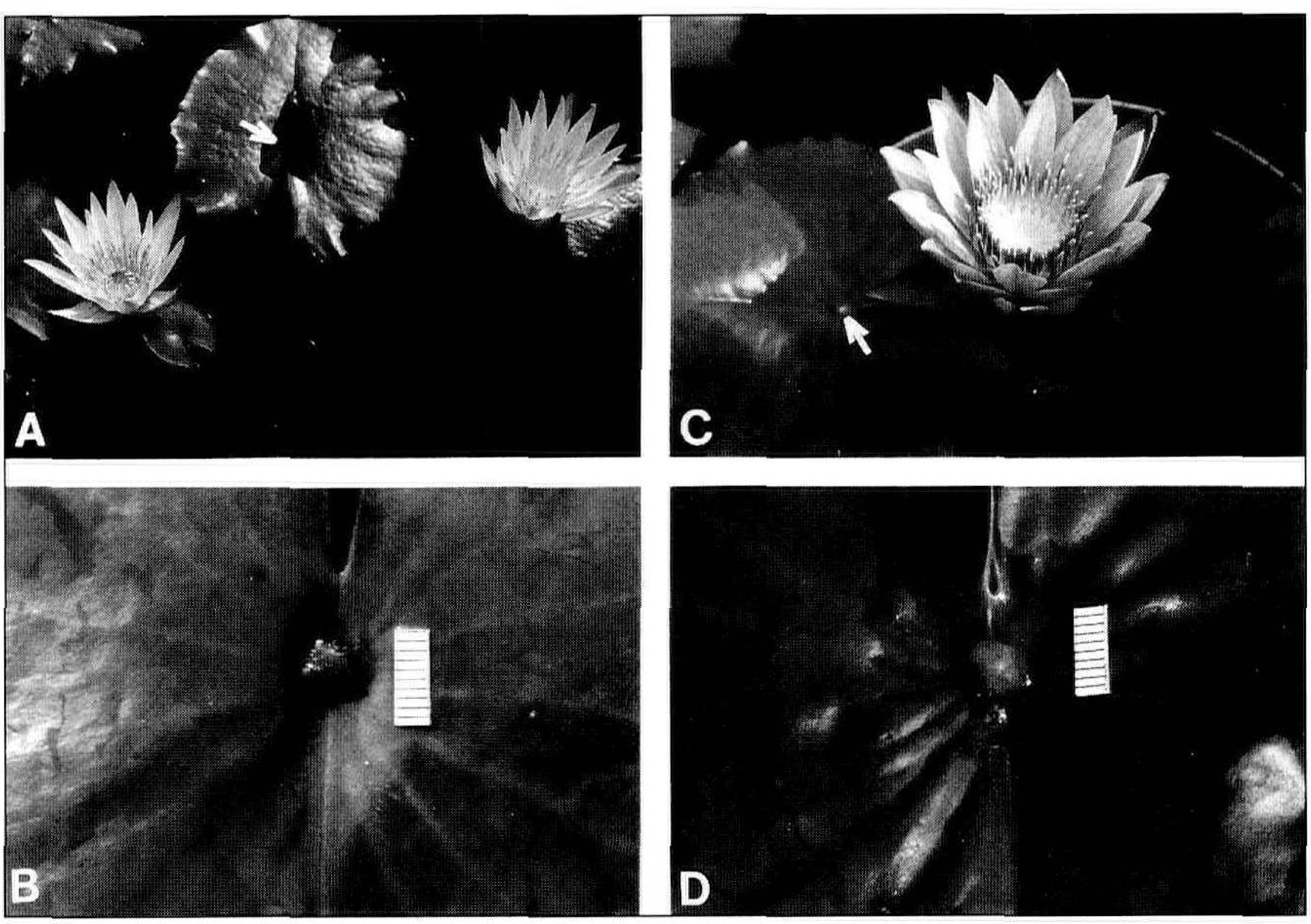

Figure 1. A. Flower and growth habit of *Nymphaea ×daubenyana*. Note presence of epiphyllous plantlet on floating leaf (arrow). **B**. Immature epiphyllous plantlet on floating leaf of *Nymphaea ×daubenyana*. Scale bar = 10 mm. **C**. Flower and growth habit of *N*. 'Shirley Bryne'. Note presence of epiphyllous plantlet on floating leaf (arrow). **D**. Immature epiphyllous plantlet on floating leaf of *N*. 'Shirley Bryne'. Scale bar = 10 mm.

made in developing commercially viable micropropagation protocols for water lilies (Jenks et al. 1990; Swindells, 1990; Lakshmanan, 1994). Consequently, other efficient production practices need to be evaluated which can be directly used by growers at minimal expense.

One alternative technique is possibly the use of plant growth regulators to enhance growth and branching. Growth regulators are widely used in the production of other ornamental crops. The use of plant growth regulator applications to enhance water lily propagation efficiency by forcing rhizome bud break has been proposed (Defeo, 1987). However, the efficacy of growth regulator applications on water lily propagation is untested. Certain tropical water lily cultivars are asexually propagated via the formation of epiphyllous ("viviparous") plantlets or offsets. These epiphyllous plantlets form at the junction of the petiole and the blade (Fig. 1). This method of propagation can be inefficient in some cultivars because of incomplete or slow plantlet development.

In a preliminary study, we examined the influence of the plant growth regulator Promalin® on epiphyllous plantlet growth in the viviparous tropical water lily hybrids *Nymphaea* ×*daubenyana* (highly viviparous) and *N.* 'Shirley Bryne' (moderately viviparous).

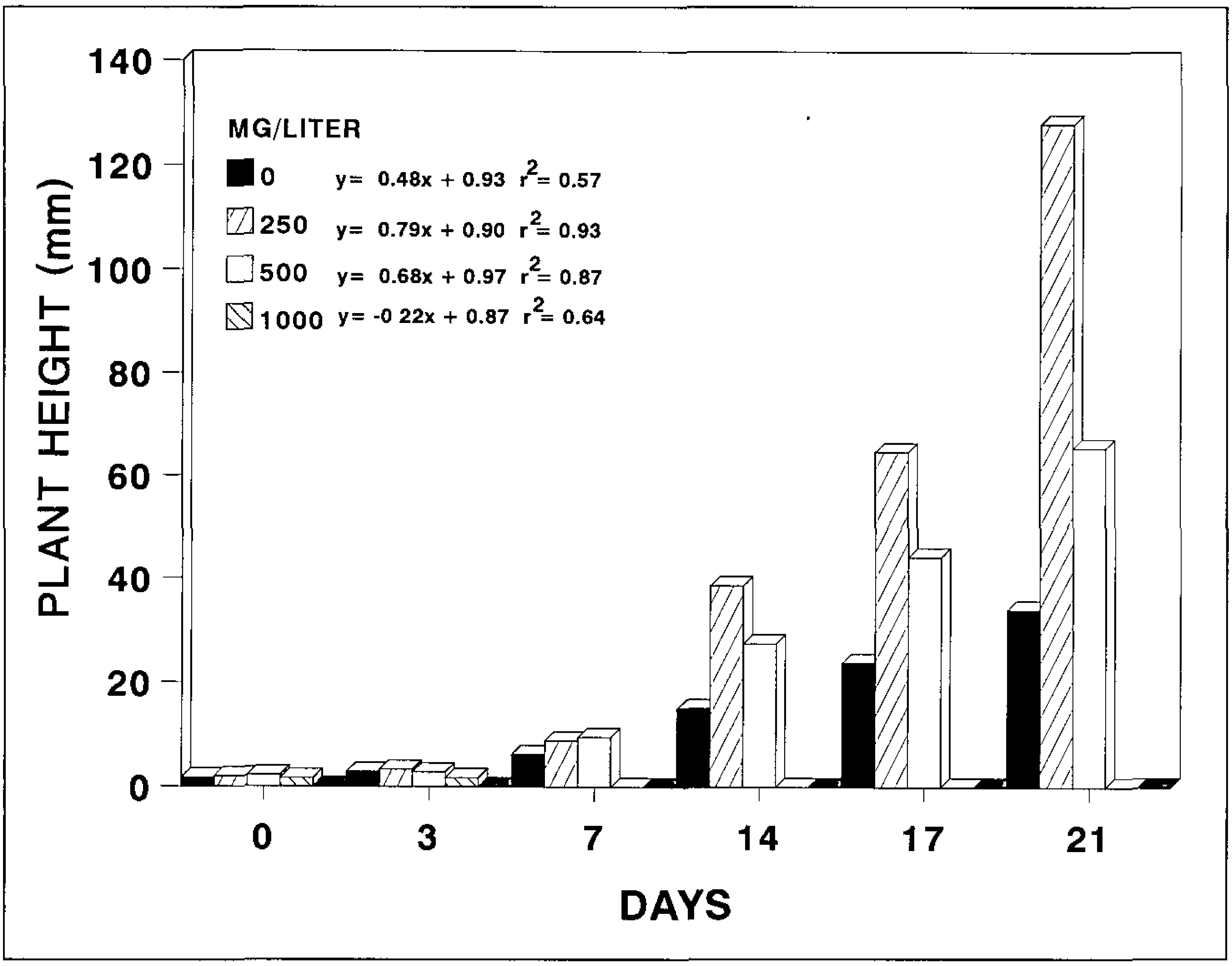

Figure 2. Effect of Promalin® on epiphyllous plantlet height in *Nymphaea* ×*daubenyana*. Each value represents the mean response of six replicate plantlets. Regression analysis was performed on logarithmically transformed data.

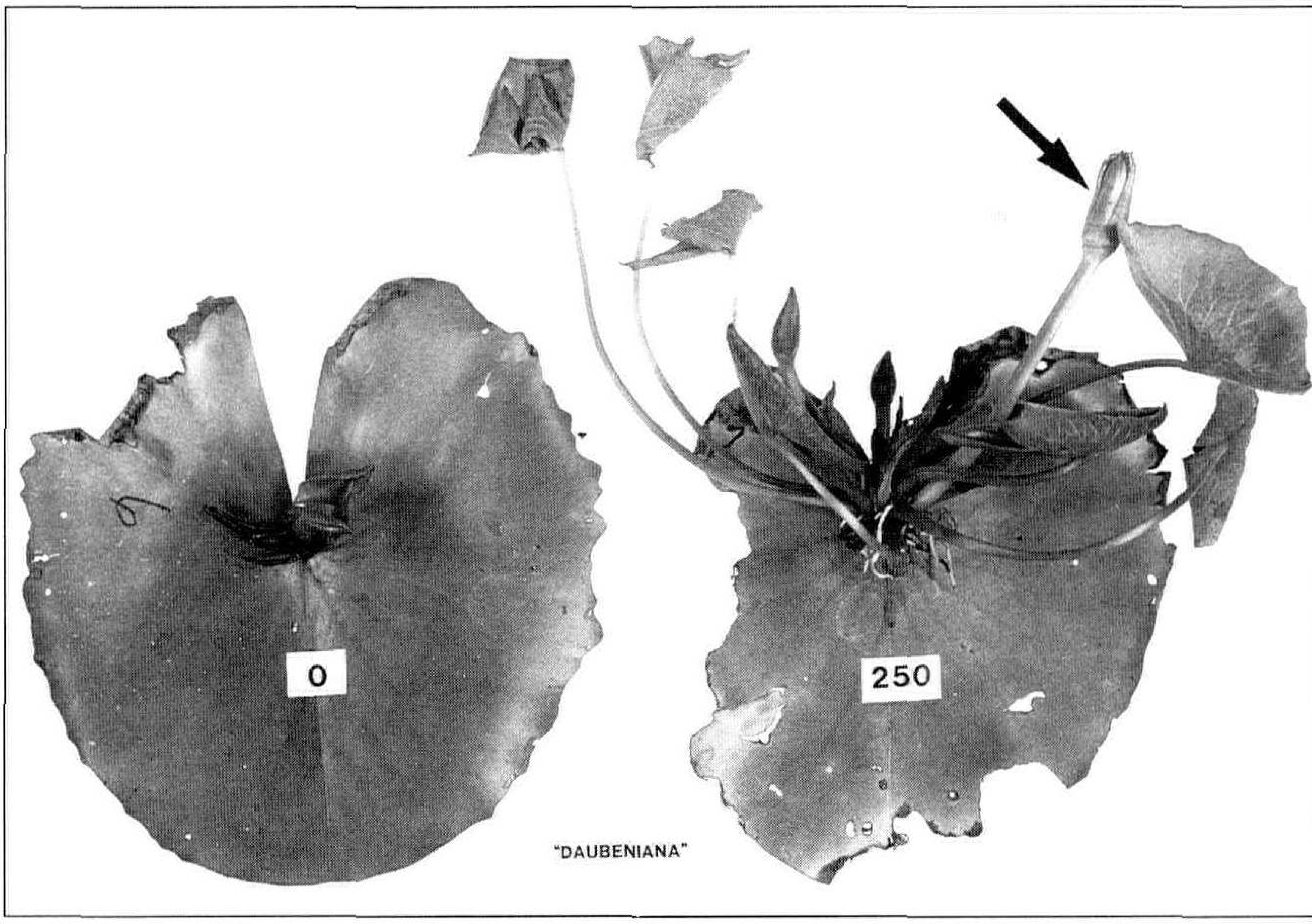

Figure 3. Effect of Promalin® at 0 and 250 mg $Liter^{-1}$ on epiphyllous plantlet development in *Nymphaea ×daubenyana* after 21 days. Note presence of flower buds (arrow) on Promalin® treated plantlet. Scale bar = 10 mm.

MATERIALS AND METHODS

Stock plants of *Nymphaea ×daubenyana* and *N.* 'Shirley Bryne' were grown individually in 19-liter (5-gal) plastic pots containing Metro-mix 500® soilless potting medium (W. R. Grace, Fogelsville, Penn.) overlaid with a 2-cm (1-inch) layer of quartz sand. Each plant was fertilized monthly with three Sierra® 16.8N-7.4P-13.9K controlled-release fertilizer tablets. Water lilies were cultured under full sun in outdoor tanks constructed of landscape timbers lined with Permalon® PLY X-210 polyolefin film (Reef Industries, Houston, Texas). Promalin® is a proprietary formulation of 1.8% (w/v) N^6-benzyladenine (BA) and $gibberellin_{4+7}$ (GA_{4+7}) from Abbott Laboratories, North Chicago, Illinois. The concentrated stock solution was diluted with deionized water to prepare stock solutions containing either 0, 250, 500, or 1000 mg $liter^{-1}$ (ppm) of BA and GA_{4+7}. Several drops of the wetting agent, Tween-20®, were added to each solution. Each treatment consisted of a specific Promalin® dilution applied as a single 50 microliter (µl) drop with a Pipetman adjustable pipette (Rainin Instrument, Woburn, Massachusetts). Treatments were applied directly to immature (1.0 to 3.0 mm long) epiphyllous plantlets on floating leaves. A 5 cm × 4 cm × 1.5 cm styrofoam collar was attached to the petiole of each floating leaf to prevent submergence of the plantlet. Treatment applications were made on day 0, 3, 7, 14, and 17 with six replicate plantlets per treatment. Measurements of epiphyllous plantlet height and basal diameter were made prior to each application. Final treatment effects on growth were determined on Day 21.

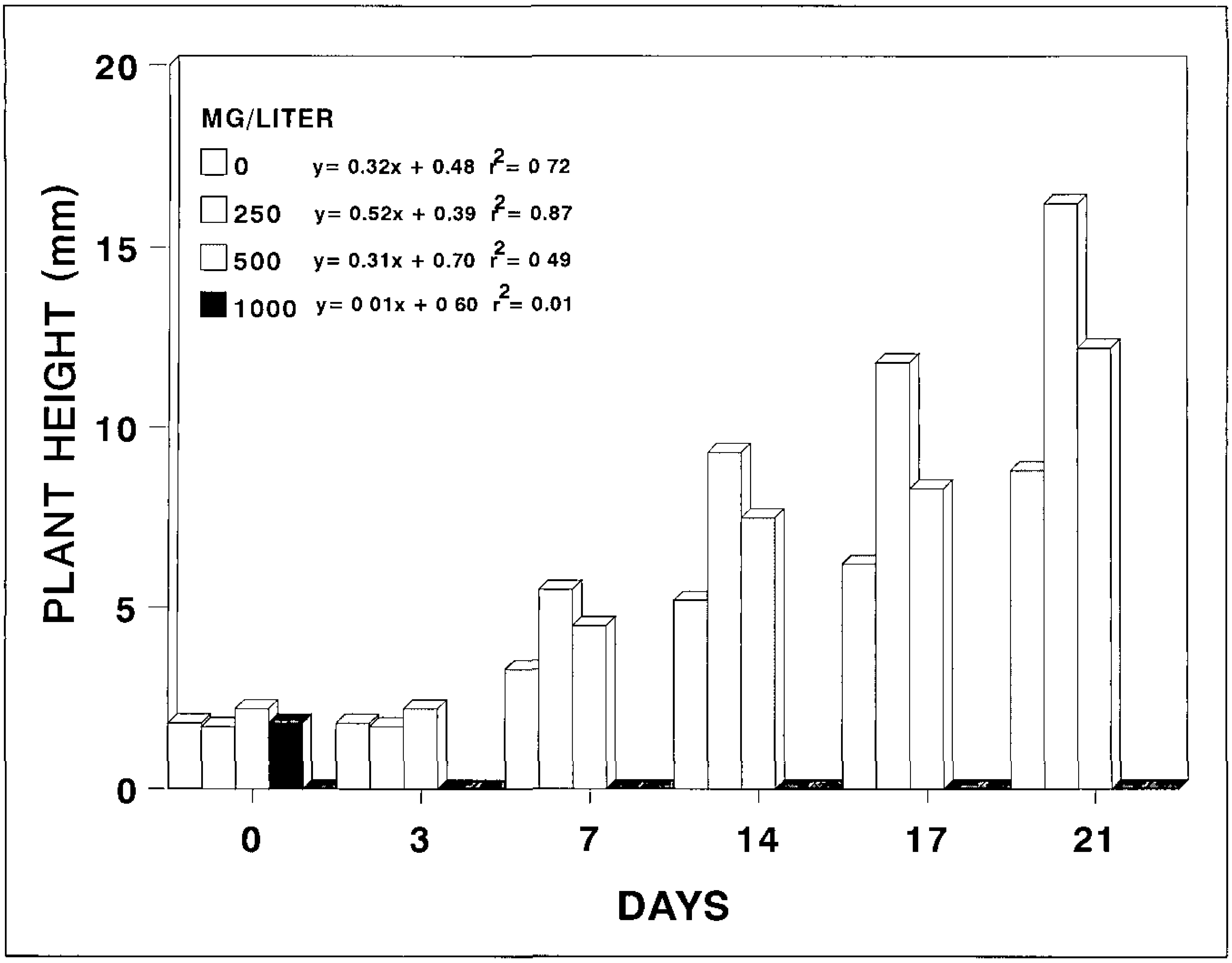

Figure 4. Effect of Promalin® epiphyllous plantlet height in *Nymphaea* 'Shirley Bryne'. Each value represents the mean response of six replicate plantlets. Regression analysis was performed on logarithmically transformed data.

RESULTS AND DISCUSSION

Nymphaea x*daubenyana* is a popular water lily which produces light blue narrow petaled flowers (Fig. 1A) and is considered highly viviparous (Masters, 1974). Promalin® treatments significantly promoted epiphyllous plantlet development in this cultivar. Treatment with either 250 or 500 mg liter^{-1} Promalin® significantly enhanced plantlet basal diameter (data not shown) over the control. However, maximum plantlet height (276% increase over untreated plantlets) was achieved following application of 250 mg liter^{-1}Promalin® (Fig. 2). By Day 21, plantlets treated with five applications of 250 mg liter^{-1} Promalin® were unbranched and highly rooted (mean: 11.3 roots per plantlet) and consisted of multiple leaves with elongated petioles and flower buds (mean: 2.8 flower buds/plantlet) (Fig. 3). Treatment with 1000 mg liter^{-1} Promalin® severely burned the epiphyllous plantlets following the second application.

Nymphaea 'Shirley Bryne' is considered a moderately viviparous water lily in which many of the epiphyllous plantlets produced do not develop to a propagatable size (D. Bryne, pers. comm.). Promalin® application also significantly promoted epiphyllous plantlet basal diameter and height in *N.* 'Shirley Bryne' (Fig. 4) but to a lesser degree than *N.* x*daubenyana*. Regardless of treatment, neither flower buds nor root development was observed on any *N.* 'Shirley Bryne' plantlets by Day 21.

Exogenously applied cytokinins promote both bud growth and branching in many plants (Wang, 1987). Cytokinin induced branching has also been shown to be enhanced with concomitant application of GA_{4+7} (Popenoe and Barritt, 1988). Although Promalin® application promoted epiphyllous plantlet growth, no branching was observed in the water lilies tested. These preliminary results, however, indicate that applications of cytokinin (BA) and gibberellins enhance epiphyllous plantlet development in viviparous water lilies and that treatment efficacy is cultivar dependent. Additional studies are required to determine the effects of: 1) other cytokinins alone and in combination with gibberellins and 2) plant growth regulator concentration and frequency of application on epiphyllous plantlet development. Any long-term effects of plant growth regulator treatment on the subsequent growth and development of the plantlets once they attain a propagatable size should be determined for each cultivar tested. However, the use of plant growth regulators for enhanced propagation of water lilies looks promising!

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